
Measurement of bioelectric current with a vibrating probe.

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Public Summary:

Electric fields, generated by active transport of ions, are present in many biological systems and often serve important functions in tissues and organs. For example, they play an important role in directing cell migration during wound healing. Here we describe the manufacture and use of ultrasensitive vibrating probes for measuring extracellular electric currents. The probe is an insulated, sharpened metal wire with a small platinum-black tip (30–35 μm), which can detect ionic currents in the $\mu\text{A}/\text{cm}^2$ range in physiological saline. The probe is vibrated at about 200 Hz by a piezoelectric bender. In the presence of an ionic current, the probe detects a voltage difference between the extremes of its movement. A lock-in amplifier filters out extraneous noise by locking on to the probe's frequency of vibration. Data are recorded onto computer. The probe is calibrated at the start and end of experiments in appropriate saline, using a chamber which applies a current of exactly 1.5 $\mu\text{A}/\text{cm}^2$. We describe how to make the probes, set up the system and calibrate. We also demonstrate the technique of cornea measurement, and show some representative results from different specimens (cornea, skin, brain).

Scientific Abstract:

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